SECTION 510

EARTH RETAINING SYSTEMS AND SOUND BARRIER WALLS

510.01. DESCRIPTION.

This work consists of constructing earth retaining systems, cast-in-place concrete sound barrier walls, and slopewalls in accordance with these Specifications and in close conformity with the lines and grades shown on the Plans or established by the Engineer.

510.02. MATERIALS.

(a) **General.** Materials shall conform to the following sections and subsections:

Structural Concrete	509
Reinforcing Steel for Structures	511
Portland Cement Concrete	701
Cover Material for Pipe Underdrains	703.04
Granular Backfill	703.05
Drainage Conduits	726

For slopewalls, use Class A concrete with coarse aggregate for thin section concrete.

(b) **Precast Elements.** Precast elements shall meet the applicable requirements of Section 503 except that Class AA concrete shall be used instead of Class P concrete.

(c) **Steel Sheet Piles.** Steel sheet piling shall conform to AASHTO M 202 or AASHTO M 270, Grade 50W (Grade 345W).

(d) **Filter Fabric.** Filter fabric shall conform to Subsection 620 of the AASHTO Guide Specifications for Highway Construction, GSH-7, 1993. Filter fabric shall prevent clogging of the drain and transmission of fines from the backfill.

(e) Granular Backfill for Mechanically Stabilized Earth (MSE) Walls. Granular backfill for MSE walls shall comply with Subsection 703.05 and the following.

The backfill material shall have an angle of internal friction of not less than 34°. Determine the angle of internal friction by the standard Direct Shear Test, AASHTO T 236, on the portion finer than the No. 10 (2mm) sieve, using a sample of material compacted to 95% of AASHTO T 99, Methods C or D (with oversized correction) at optimum moisture content. No testing is required for backfills where 80% of sizes are greater than $^3/_4$ inch (20mm).

If the backfill material is to be used with steel soil reinforcement, use backfill material meeting the following electrochemical requirements:

- pH of 5 to 10,
- Resistivity 30 ohm meters,
- Chlorides 100 parts per million,
- Sulfates 200 parts per million.

510.04. CONSTRUCTION METHODS.

(a) **General.** For earth retaining systems and noise barrier walls, use construction methods conforming to Sections 501, 502, 509, 510, 511, and 613.

Alternative designs for earth retaining systems and noise barrier walls may be used if permitted in the contract documents. Obtain the working drawing approval before using an alternative design.

(b) **Working Drawings.** Provide working drawings and design calculations for alternative earth retaining systems and alternative design noise barrier walls, or when required by the contract documents. Comply with Subsection 105.02. Include the following items in the working drawings and design calculations:

- Verification of existing ground elevations for each structure involving construction in original ground,
- The layout of the wall that will effectively retain the earth (for retaining walls) or block noise (for noise barrier walls) but not less in height or length than the wall system shown in the contract documents,
- Complete design calculations substantiating that the proposed design satisfies the design parameters in the contract documents,
- Complete details of all elements required for the proper construction of the system, including complete material specifications,
- Earthwork requirements including specifications for material and compaction of backfill (for retaining walls),
- Details of revision or additions to drainage systems or other facilities required to accommodate the system,
- Other information required in the contract documents or requested by the Engineer.

Provide working drawings for concrete walls that have an architectural finish required. Show the layout for the form liners. Identify each piece of form liner. Show the sequence of construction.

(c) **Backfill.** Place backfill material within the neat lines shown on the plans. For retaining walls, use granular backfill of the type specified.

(d) **Drainage.** Construct drainage facilities in accordance with the details shown on the approved working drawings or in the contract documents and these specifications.

1. *Concrete Gutters.* Construct concrete gutters to the profile indicated in the contract documents or on the approved working drawings. Provide outlet works at sags in the profile, at the low of the gutter, and at other indicated locations.
2. *Weep Holes.* Construct weep holes at the locations shown in the contract documents or on the approved working drawings. Place a minimum of 2 ft^3 ($0.06m^3$) of coarse cover material for pipe underdrains encapsulated with filter fabric at each weep hole.

   Cover the joints between precast concrete retaining wall face panels that function as weep holes with filter fabric. Bond the filter fabric to the face panels with adhesive conforming

to Federal Specification MMM-A-121. The face panels that are to receive the filter fabric shall be dry and thoroughly cleaned of dust and loose materials.

3. *Drainage Blankets.* Construct drainage blankets consisting of coarse cover material for pipe underdrains encapsulated in approved filter fabric or filter sand, collector pipes, outlet pipes, and cleanout pipes as specified in the contract documents or on the approved working drawings.

Prepare the subgrade for filter fabric installation by compacting to the specified density and grading to the specified elevation. Remove any extraneous material and sharp objects that may damage the fabric during installation. Stretch and align the fabric, and place in a wrinkle-free manner. Overlap adjacent borders from 12 inches (300mm) to 18 inches (450mm). Repair torn or punctured fabric by placing a piece of fabric that is large enough to cover the damaged area and meet the overlap requirement.

Place the coarse cover material in horizontal layers and thoroughly compact. Do not pond or jet the coarse cover material or adjacent backfill. During spreading and compacting of the cover material, maintain a minimum of 6 inches (150mm) of cover material between the fabric and the construction equipment.

Place the perforated collector pipe within the cover material to the elevations shown. Place outlet pipes at sags in the flow line, at the low of the collector pipe, and at other indicated locations. Place cleanout pipes at the high ends of collector pipes and at other indicated locations.

4. *Geocomposite Drainage Systems.* Install geocomposite drainage systems at the locations shown in the contract documents or on the approved working drawings. Place and tightly secure the geocomposite drainage material against the excavated face, lagging, or back of wall as specified in the contract documents. When concrete is to be placed against geocomposite drainage material, protect the drainage material against physical damage and grout leakage.

(e) **Wall Systems.**

1. *Cast-in-place Concrete Walls.*

1.1 *Architectural Finish.* When the plans specify an architectural finish on the exposed surface(s) of the wall, comply with the following requirements:

- Submit a sample of the form liner for approval (with working drawings).
- Use as few joints in the form liner as possible.
- Discard and replace damaged form liner.

1.2 *Retaining Wall Placement.* Unless otherwise specified, cast retaining walls with a 1% batter (leaning toward the backfill side) to compensate for wall deflection caused by the backfill material. Do not backfill until all sections within a continuous section of wall have been cast and cured by Subsection 509.

1.3 *Vertical Precast Concrete Wall Elements with Cast-in-Place Concrete Footings.* Adequately support and brace wall elements to prevent vertical or horizontal displacement until footing concrete has been placed, completely cured, and has sufficient strength to support the wall elements. Comply with Section 502.

2. *Mechanical Stabilized Earth (MSE) Walls.* The construction of MSE retaining walls shall consist of constructing a facing system to which steel or polymeric soil reinforcement is connected and the placing of structure backfill material surrounding the soil reinforcement.

2.1 *Facing.* Provide facing consisting of precast concrete panels that conforms to the details and materials specified in the contract documents or on the approved working drawings.

Provide a Class 2, Rubbed finish or the architectural treatment specified in the contract documents. The face not exposed to view shall have a uniform surface finish free of open pockets of aggregate or surface distortion in excess of $^1/_4$ inch (6mm). Accurately locate and secure soil reinforcement connection hardware during concrete placement. Do not allow contact of hardware with the facing reinforcing steel.

2.2 *Soil Reinforcement.* Provide galvanizing according to AASHTO M 111 for all steel soil reinforcement and steel connection hardware.Steel strip reinforcement shall be hot rolled to the required shape and dimensions. The steel shall conform to AASHTO M 223, Grade 65 (Grade 450) , unless otherwise specified in the contract documents.

Welded wire fabric reinforcement shall be shop fabricated from cold-drawn wire of the sizes and spacings specified in the contract documents or on the approved working drawings. The wire shall conform to AASHTO M 32. The fabricated fabric shall conform to AASHTO M 55.

Polymeric reinforcement shall be of the type and size specified in the contract documents or on the approved working drawings.

Connection hardware shall conform to the contract documents or the approved working drawings.

2.3 *Construction.* When required, provide a cast-in-place concrete leveling pad for entire length of wall. Prepare foundation material under level pad according to Section 501.

Place and support panels as necessary so that their final position is vertical or battered as shown in the contract documents or on the approved working drawings within a tolerance of +0%, -1%. (The minus direction leans toward the backfill.)

Install joint filler, bearing pads, and joint covering material concurrently with face panel placement.

Place and compact granular backfill for MSE walls simultaneously with the placement of facing and soil reinforcement. Place and compact without distorting or displacing the facing panels or soil reinforcement. Do not use sheeps foot or grid-type rollers for compacting granular backfill. Roughly level the backfill material at each level of soil reinforcement to an elevation approximately 1 inch (25mm) above the connection at the facing before placing the soil reinforcement. Uniformly tension all soil reinforcement to remove any slack in the connection or soil reinforcement.

(f) **Slopewalls.** Construct slopewalls according to requirements for concrete sidewalks in Section 610. Do not place horizontal construction joints in the slopewalls. Space vertical construction joints less than 10 feet (3m) measured along the top of slopewall. The final number and location of construction joints will be determined in the field by the Engineer.

510.05. METHOD OF MEASUREMENT.

The *retaining walls* and *sound barrier walls* will be measured for payment by the accepted area of wall as measured from the top of the footing to the top of the wall.

Items used in wall construction including, but not limited to, excavation, backfill, backfill material, concrete, reinforcing steel, form liners, perforated pipe underdrain, geocomposites, filter fabric, pipe underdrain cover material, concrete surface finish, and sheeting and shoring, will not be measured for payment. Include the cost of these unmeasured items in the price bid for wall construction.

Drilled shafts and piling will be measured and paid for as specified for drilled shaft and piling pay items.

Slopewall will be measured by the surface area of completed slopewall, according to the dimensions shown on the plans or required by the Engineer.

510.06. BASIS OF PAYMENT.

Accepted quantities of retaining wall, sound barrier wall, and slopewall will be paid for at the contract unit price for:

(A) RETAINING WALL ..... SQUARE YARD (SQUARE METER)
(B) SOUND BARRIER WALL ..... SQUARE YARD (SQUARE METER)
(C) SLOPEWALL ..... SQUARE YARD (SQUARE METER)

which will be full compensation for all labor, material, equipment, and incidentals necessary to complete the respective work.

SECTION 511
REINFORCING STEEL FOR STRUCTURES

511.01. DESCRIPTION.

This work consists of furnishing and placing reinforcing steel in accordance with the contract documents. Reinforcing steel consists of deformed bars, epoxy coated deformed bars, and cold drawn wire mesh as specified.

511.02. MATERIALS.

(a) **General.** Reinforcing steel shall meet the requirements of Section 723, except the strength requirement shall conform to grade 60 (420) unless otherwise specified in the special provisions or plans. Furnish cold drawn wire for spiral ties and other reinforcing designated in W (wire) sizes.

(b) **Bar Lists and Bending Diagrams.** The bar list and bending diagrams shown in the contract documents are provided for estimating quantities. Bent bars are dimensioned out-to-out. Verify the quantity, size and shape of the bar reinforcement against the structure drawings and make necessary corrections before ordering.

If detailed bar lists and bending diagrams are not provided, submit such lists and diagrams for approval according to Subsection 105.02. Do not fabricate before the lists and diagrams